



Aviation Systems Division (Code AF) FY14 Technical Highlights

In fiscal year 2014, the Aviation Systems Division's tremendous technical output contributed to the development of research results, new concepts, automation tools, and procedures for improving the efficiency and capacity of the air transportation system.

Technology Transfer

Two new technologies were transferred to external customers:

Precision Departure Release Capability (PDRC) was officially delivered to the Federal Aviation Administration (FAA) in Aug. 2014. PDRC research was led by the NASA North Texas Research Station (NTX) and demonstrated the ability to improve off-time compliance to 83% (from current-day levels of 54%). PDRC also has the potential to improve metering schedules for over 20% of arriving aircraft at today's Traffic Management Advisor (TMA)-metered airports.

Traffic and Atmospheric Information for General Aviation (TAIGA) was officially delivered to the State of Alaska, completing the technical work in 2014. TAIGA, a collection of algorithms, concepts and data, is the result of a joint effort between NASA Ames Research Center and the State of Alaska. TAIGA is designed to help pilots make better flight decisions in the challenging Alaskan airspace, especially when the typical sources of pilot information, such as the Internet, telephone, and flight services, are not available.

ATD-1/TSS

During 2014, the Air traffic management (ATM) Technology Demonstration-1 (ATD-1) team continued to conduct human-in-the-loop (HITL) simulations to further refine

the Terminal Sequencing and Spacing (TSS) technology towards the Operational Integration Assessment (OIA) at the FAA's William J. Hughes Technical Center (WJHTC), scheduled for May 2015. The OIA objective



NASA Administrator, Mr. Charles Bolden, with Aviation Systems Division staff

NASAfacts



Human-in-the-loop simulation for testing of ATD-1's Terminal Sequencing and Spacing (TSS) technologies

is to identify and mitigate TSS operational integration risks. The Time-Based Flow Management (TBFM) and Standard Terminal Automation Replacement System (STARS)-Elite prototype systems, enhanced with TSS functionality, will be integrated with the FAA's operational En Route Automation Modernization (ERAM) system. The FAA's National Air Traffic Controller Association (NATCA) terminal area controllers will evaluate TSS; their feedback will help refine the procedures and training requirements for the operational environment.

TDS-T

The Tactical Departure Scheduling – Terminal (TDS-T) team successfully completed an initial shadow evaluation in July 2014. TDS-T addresses the challenge of simultaneously satisfying national, regional, and local departure constraints while accommodating traffic from both well-equipped and less-equipped airports. The TDS-T team at the NTX laboratory analyzed nationwide terminal departure operations to assess potential benefits and establish requirements, designed and evaluated a new terminal departure scheduling algorithm, and implemented the scheduling algorithm in a TDS-T prototype decision support tool. FAA subject matter experts from terminal area and airport facilities in the Dallas-Fort Worth area participated in an initial shadow evaluation, providing feedback on the TDS-T concept and tool.

EDA Deployment

Technology based on the first phase of NASA's Efficient Descent Advisor (EDA) was declared operational at Albuquerque Air Route Traffic Control Center (ARTCC) in Sept. 2014. NASA transferred EDA to the FAA in Nov. 2011. The automation, referred to as Ground-Based Interval Management for Spacing (GIM-S) by the FAA, provides controllers with speed advisories for

accurately delivering aircraft to arrival metering fixes. The targeted metering times are computed by the FAA's TBFM scheduler, which is also based on previous NASA research and development. Using speed advisories coupled with extended metering capabilities, controllers can condition arrival flows to balance demand and capacity and facilitate optimal profile descents up to 600 miles from the destination airport. Initial reports from controllers are very favorable. Efforts are underway within the FAA to examine the expansion of the GIM-S deployment to additional en route centers, including Oakland, Los Angeles, and Denver.

UAS

The Unmanned Aircraft Systems (UAS) Integration into the National Airspace System (NAS) Project completed a number of HITL simulations and flight tests in collaboration with Armstrong and Langley Research Centers, designed to gather data that will further enable unmanned aircraft to fly in the NAS and establish the definitions of airborne separation standards and the appropriate time and distance thresholds at which to notify the pilot of potential collision situations. In addition to providing key data to understand required separation guidelines, the simulations represented the successful integration of multiple, distributed simulation participants, including Ames, Armstrong, Langley, and Glenn Research Centers, using virtual background traffic and live UAS with ground control stations and research partners including the FAA, Honeywell, and General Atomics.

DWR

The Dynamic Weather Routes (DWR) tool continued testing at American Airlines (AA) Integrated Operations Center (IOC) throughout FY14. In May 2014, the DWR software that supports the operational trial of DWR at the AA IOC was upgraded. The new version of DWR expanded air traffic coverage beyond Fort Worth ARTCC, to include first-tier adjacent centers (Albuquerque, Kansas City, Memphis, and Houston). An analysis of the DWR potential benefits from the field testing showed that AA saved more than 3,300 flying minutes for over 540 AA revenue flights; 48 flights demonstrated an estimated savings of 15 min. or more each. Assuming an operating cost of \$75/min., these results translate to \$248K in savings. Substantial additional savings could be presumed with reductions in diversions, missed connections, or flight cancellations. The DWR software was licensed to The Boeing Company in 2014.

SARDA

The Spot and Runway Departure Advisor (SARDA) team completed an impressive six HITL simulations at Ames' FutureFlight Central (FFC). The team developed a decision support capability for airline ramp controllers,

and provided a convincing proof-of-concept for improving efficiency of overall surface traffic and pushback operations in particular. In addition to a gate pushback advisory scheduler, and departure and arrival runway crossing sequencing advisories, the team developed the ramp traffic console (RTC) touchscreen user interface as a digital replacement for current-day paper strips. AA partnered with NASA to provide ramp controllers for the simulations. The team is on track for an operational demonstration in 2016.

MESAR

The Method to Enhance Scheduled Arrival Robustness (MESAR) research team completed HITL simulations in Aug. and Sept. 2014 to test tactical updates to arrival schedules, enhancing TSS. MESAR detects potential “scheduling disturbances,” which are traffic conditions that cause a controller to abandon the schedule and revert to less-efficient relative spacing operations. Once detected, MESAR can reschedule subsets of flights within the feeder sectors without rescheduling flights far from the scheduling disturbance (including propagating delay to the Center), provide time to recover from disturbances, and facilitate return to schedule-based operations.

TFM

In Dec. 2013, Metron Aviation presented results of the NASA Research Announcement (NRA) effort, “Weather Translation Models for Strategic Traffic Flow Management (TFM)” performed by Metron and the Science and Technology in Atmospheric Research (STAR) Institute. Several weather translation models developed and enhanced during the course of this project were discussed, including the Integrated Airport Capacity Model (IACM), the Winter Weather Airport Capacity Model (WWACM), and the Turbulence Avoidance Model. A new probabilistic avoidance algorithm, generating robust sets of rerouting options that avoid multiple simultaneous weather constraints such as convective storm and turbulence avoidance, was presented. TFM researchers also held technical interchanges with AA IOC and the FAA’s WJHTC on wind-optimal routes along the North Atlantic Track System, and the Miles-in-Trail (MIT) passback restrictions model.

SimLabs

NASA Ames’ Vertical Motion Simulator (VMS) demonstrated the wide versatility of its capabilities during FY14 by hosting simulations supporting development of an innovative airship concept proposed by LTA Corporation as well as a series of simulations investigating pilot loss of control (LOC). The Division’s Aerospace Simulation Research and Development Branch (SimLabs) also hosted simulations in the Advanced Concepts Flight Simulator (ACFS) at the



The SARDA team conducts a shakedown simulation of the ramp scheduler in FutureFlight Central.

Crew-Vehicle Systems Research Facility (CVSRF), investigating aircraft safety in a study of the Tactical Flight Management System with onboard Maneuvering Envelope (TFMS-ME).

Visits

In 2014, the Aviation Systems Division had the special privilege of hosting NASA Administrator Charles Bolden in two separate visits. In March 2014, Mr. Bolden visited Ames where he viewed demonstrations of the ATD-1 technologies as well as the SARDA capabilities in FFC. In Sept., Mr. Bolden visited NTX, Fort Worth ARTCC, and AA, for briefings and demonstrations of the PDRC and DWR technologies. Mr. Bolden was accompanied by NASA Associate Administrator for Aeronautics, Dr. Jaiwon Shin, and Ames Deputy Center Director, Mr. Lewis Braxton III, as well as FAA Southwest Regional Administrator, Mr. Kelvin Solco. At a press conference hosted at AA, moderated by DFW Airport’s Executive Vice President for Operations, Mr. James Crites, and including Mr. Solco, Mr. Sean Donohue (Chief Executive Officer of DFW Airport), and Mr. Robert Isom (Chief Operating Officer of AA), all parties pledged to continue the strong partnerships that had already been exhibited by the successful technologies showcased during the NASA Administrator’s Visit.

Collaborations

In Nov. 2013, NASA Ames and the University of Cincinnati (UC) officially signed a Space Act Agreement for collaborative research in areas pertinent to the Aviation Systems Division, including Unmanned Aerial Vehicles (UAVs), software engineering, aerospace and aviation systems, data analytics, and simulation, at a ceremony honoring the late Neil Armstrong, the first person to walk on the moon, and former aerospace engineering professor at UC from 1971-1979. UC President Santa Ono signed the agreement during



UC President Santa Ono, and then Division Chief and UC alumnus, Tom Davis at the University's new on-campus exhibit titled, "Neil Armstrong: The Life and Flight of a Reluctant Hero"

a ceremony establishing the Neil Armstrong Space Science Institute. Then Division Chief Tom Davis, a UC alumnus, and Division researcher Dr. Todd Lauderdale, represented NASA Ames at the ceremony.

The Division continued to work with international partners, in terminal area scheduling research, modeling and simulation of foreign airspaces, optimization techniques and wind-optimal routes, airport surface conflict detection, and aviation environmental mitigation. Collaborating partners included the Electronic Navigation Research Institute (ENRI, Japan), the Japanese Aerospace Exploration Agency (JAXA), Ecole Nationale de l'Aviation Civile (ENAC -Toulouse, France), the German Aerospace Center (DLR - Hamburg and Braunschweig, Germany), and the Dutch National Aerospace Laboratory (NLR - Amsterdam, The Netherlands). The Division also continues active collaborations with numerous US universities, including the Center for Human factors in Advanced Aeronautics Technologies (CHAAT) laboratory at California State University at Long Beach, the University of California at Berkeley, and Stanford University.

Outreach

During the fiscal year, Division researchers gave invited presentations on a wide range of air traffic research and simulation capabilities to public audiences as well as university groups. SimLabs participated in NASA Ames' "Bring Your Family to Work Day" in April 2014, which welcomed 139 employees, family members, and interns to the Division's VMS and FFC. In Sept. 2014,



During Ames' "Bring Your Family To Work Day," guests were invited to visit the Vertical Motion Simulator, where they could sit in a customized aerospace vehicle.

both SimLabs and ATM researchers participated in showcasing NASA's work at Palo Alto Airport Day for hundreds of local visitors.

Technical Publications and Conferences

The Division produced 53 technical papers in FY14, in journals, at technical conferences, and in NASA technical publications. Division staff participated in many technical conferences throughout the year, including the Digital Avionics Systems Conference (DASC 2013), American Institute of Aeronautics and Astronautics (AIAA) SciTech 2014, AIAA Aviation 2014, and the Human-Computer Interaction (HCI) Aero Conference 2014.

In Fond Remembrance

The Division tragically lost several members in 2014. Mr. Eric Gardner, a long-time SimLabs engineer with SAIC, passed away in Feb. 2014. Mr. Julian Petersen, a University Affiliated Research Center (UARC) senior software engineer who worked in the TFM research area, passed away in May 2014. In Nov. 2014, Dr. Neil Chen, a TFM researcher with expertise in noise and emissions, and the beloved organizer of the Division's Basketball league, passed away suddenly. We will miss these gentlemen not only for their technical contributions to our Division but for their friendship and good humor.

More Information

For more information about the Aviation Systems Division, please visit:

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